

JOEL W. AGER III

EDUCATION:

A.B., Magna cum Laude in Chemistry, Harvard College, 1982

Ph.D. Chemical Physics, University of Colorado, 1986

PROFESSIONAL EXPERIENCE:

Staff Scientist, Materials Sciences Division, Lawrence Berkeley Laboratory, Berkeley, CA, 1990 - present

Postdoctoral Researcher, Materials Sciences Division, Lawrence Berkeley Laboratory, 1989 - 1990.

Postdoctoral Researcher, Physikalisch-Chemisches Institut, Universität Heidelberg, Heidelberg, Germany, 1987 - 1988.

CURRENT SCIENTIFIC ACTIVITIES:

Project Management: PI in Electronic Materials Program, Center for Advanced Materials. Currently Principal Investigator or co-Principal Investigator of four Cooperative Research and Development Agreement (CRADA) or Work for Others (WFO) projects with industrial partners

Raman spectroscopy of semiconductors: Measurement and modeling of stress distributions in heteroepitaxial semiconductor structures. Local vibrational mode (LVM) spectroscopy. Spectroscopic measurements under high pressure.

Raman spectroscopy and catalysis. Development of UV Raman spectroscopy as an *in-situ* probe of surface species on industrial catalysts.

Carbon films: Developed multilayer carbon films with extreme hardness (60% of diamond hardness), low stress, superior adhesion, and low wear. Studying field emission properties of carbon and carbon nanotube films.

Manufacturing Technology: In collaboration with Applied Materials and Ultrapointe developed methodology based on Raman and photoluminescence spectroscopies for definitive identification of organic and ceramic microcontaminants on Si wafers.

PUBLICATIONS:

Over 80 refereed journal articles.

I. Refereed Journals (85 as of 6/1/00)

1. C.L. Talcott, J.W. Ager III, and C.J. Howard, "Gas phase studies of Na diffusion in He and Ar and kinetics of Na + Cl₂ and Na + SF₆," *J. Chem. Phys.* **84**, 6161-6169 (1986).
2. J.W. Ager III and C.J. Howard, "Laboratory studies of gas phase sodium diffusion," *J. Chem. Phys.* **85**, 3469-3475 (1986).
3. J.W. Ager III, C.L. Talcott, and C.J. Howard, "Gas phase kinetics of the reactions of Na and NaO with O₃ and N₂O," *J. Chem. Phys.* **85**, 5584-5592 (1986).
4. J.W. Ager III and C.J. Howard, "The kinetics of NaO + O₂ + M and NaO + CO₂ + M and their role in atmospheric sodium chemistry," *Geophys. Res. Lett.* **13**, 1395-1398 (1986).
5. J.W. Ager III and C.J. Howard, "Gas phase kinetics of the reactions of NaO with H₂, D₂, H₂O, and D₂O," *J. Chem. Phys.* **87**, 921-925 (1987).
6. J.W. Ager III and C.J. Howard, "Rate coefficient for the gas phase reaction of NaOH with CO₂," *J. Geophys. Res.* **92**, 6675-6678 (1987).
7. J.W. Ager III, D. Kirk Veirs, and G.M. Rosenblatt, "Raman intensities and interference effects for thin films adsorbed on metals," *J. Chem. Phys.* **92**, 2067-2076 (1990).
8. D.K. Veirs, J.W. Ager III, E.T. Loucks, and G.M. Rosenblatt, "Mapping materials properties with Raman spectroscopy utilizing a two-dimensional detector," *Applied Optics* **29**, 4969-4980 (1990).
9. J.W. Ager III, D.K. Veirs, J. Shamir, and G. M. Rosenblatt, "Laser heating effects in the characterization of carbon fibers by Raman spectroscopy," *J. Appl. Phys.* **68**, 3598-3608 (1990).
10. J.W. Ager III, D.K. Veirs, and G.M. Rosenblatt, "Spatially resolved Raman studies of CVD diamond films, *Phys. Rev. B* **43**, 6491-6499 (1991).
11. B. Marchon, N. Heiman, M.R. Khan, A. Lautie, J.W. Ager III, and D.K. Veirs, "Raman and resistivity investigations of carbon overcoats of thin film media - correlations with tribological properties," *J. Appl. Phys.* **69**, 5748-5750 (1991).
12. D.K. Veirs, J.W. Ager III, and G.M. Rosenblatt, "Materials characterization by imaging Raman spectroscopy," *Ceramic Trans.* **19**, 1043-1050 (1991).
13. B. Marchon, P.N. Vo, M.R. Khan, and J.W. Ager III, "Structure and mechanical properties of hydrogenated carbon films prepared by magnetron sputtering," *IEEE Trans. Magn.* **22**, 5160-5162 (1991).
14. B. Bhushan, A.J. Kellock, N.-H. Cho, and J.W. Ager III, "Characterization of chemical bonding and physical characteristics of diamond-like amorphous carbon and diamond films," *J. Mat. Res.* **7**, 404-410 (1992).
15. N.-H. Cho, D.K. Veirs, J.W. Ager III, M.D. Rubin, C.B. Hopper, and D.B. Bogy, "Effect of substrate temperature on chemical structure of amorphous carbon films," *J. Appl. Phys.* **71**, 2243-2248 (1992).
16. M.C. Salvadori, M.A. Brewer, J.W. Ager III, I.G. Brown, and K.M. Krishnan, "The effect of a graphite holder on diamond synthesis by microwave plasma chemical vapor deposition," *J. Elec. Chem. Soc.* **139**, 558-560 (1992).
17. M.C. Salvadori, J.W. Ager III, I.G. Brown, and K.M. Krishnan, "Diamond synthesis by microwave plasma CVD using graphite as the carbon source," *Appl. Phys. Lett.* **59**, 2386-2388 (1991).

18. M.C. Salvadori, J.W. Ager III, and I.G. Brown, "Diamond growth on silicon nitride by microwave plasma CVD, *Diamond and Related Mat.* **1**, 818 (1992).
19. L.S. Pan, D.R. Kania, P. Pianetta, M. Landstrass, J.W. Ager III, S. Han, and O.L. Landen, "Carrier mobility and lifetime measurements in undoped CVD diamond films," *Science* **255**, 830-833 (1992).
20. D.E. Bliss, W. Walukiewicz, J.W. Ager III, E.E. Haller, K. Chan, and S. Tanigawa, "Annealing characteristics of low temperature grown GaAs:Be," *J. Appl. Phys.* **71**, 1699-1707 (1992).
21. J.N. Heyman, J.W. Ager III, E.E. Haller, N.M. Johnson, J. Walker, and C.M. Doland, "Hydrogen-induced platelets in silicon: Infrared and Raman scattering," *Phys. Rev. B* **45**, 13363-13366 (1992).
22. J.W. Ager III, "Optical characterization of sputtered carbon films," *IEEE Trans. Magn.* **29**, 259-263 (1993).
23. J.H. Nickel, D.E. Morris, and J.W. Ager III, "Locus of pairing interaction in YBa₂Cu₃O₇ by site-selective oxygen isotope shift: ¹⁸O in CuO₂ plane layers, *Phys. Rev. Lett.* **70**, 81-84 (1993).
24. L.S. Pan, D.R. Kania, P. Pianetta, J.W. Ager III, M. Landstrass, and S. Han, "Temperature dependent mobility in single-crystal and CVD-deposited diamond," *J. Appl. Phys.* **73**, 2888-2894 (1993).
25. S. Han, S.G. Prussin, J.W. Ager III, L.S. Pan, D.R. Kania, S.M. Lane, and R.S. Wagner, "Radiation damage study of polycrystalline CVD and natural type IIa diamonds using Raman and photoluminescence spectroscopies, *Nucl. Instr. Meth. B* **80**, 1446-1450 (1993).
26. L.S. Pan, S. Han, D.R. Kania, S. Zhao, K.K. Gan, H. Kagan, R. Kass, M. Malchow, F. Morrow, W.F. Palmer, C. White, S.K. Kim, F. Sannes, S. Schnetzer, R. Stone, G.B. Thomson, Y. Sugimoto, A. Fry, S. Kanda, S. Olsen, M. Franklin, J.W. Ager III, P. Pianetta, "Particle- and photo-induced conductivity in type IIa diamonds, *J. Appl. Phys.* **74**, 1086-1095 (1993).
27. M.S. Plano, M.I. Landstrass, L.S. Pan, S. Han, D.R. Kania, S. McWilliams, and J.W. Ager III, "Polycrystalline diamond films with high electrical mobility," *Science* **260**, 1310-1312 (1993).
28. J. W. Ager III and M. D. Drory, "Quantitative measurement of residual biaxial stress by Raman spectroscopy in diamond grown on Ti-6Al-4V by chemical vapor deposition," *Phys. Rev. B* **48**, 2601-2607(1993).
29. S. S. Perry, J.W. Ager III, and G.A. Somorjai, "Combined surface characterization and tribological (friction and wear) studies of CVD diamond films," *J. Mater. Sci.* **8**, 2577-2586 (1993).
30. S. Im. J. Washburn, R. Gronsky, N.W. Cheung, K.M. Yu, and J.W. Ager III, "Optimization of Ge/C ratio for compensation of misfit strain in solid phase epitaxial growth of SiGe layers," *Appl. Phys. Lett.* **63**, 2682-2684 (1993).
31. L. J. Oblinsky, T. M. Devine, J. W. Ager III, S. S. Perry, S. L. Mao, and R. E. Russo, "Surface-enhanced Raman scattering from pyridine adsorbed on thin layers of stainless steel," *J. Electrochem. Soc.* **141**, 3312-3317 (1994).
32. J. W. Ager III, S. Han, S. G. Prussin, R. S. Wagner, L. S. Pan, D. R. Kania, and S.M. Lane, "Spatially resolved measurement of lattice damage in alpha-particle-irradiated natural IIa diamond by confocal photoluminescence microscopy," *J. Appl. Phys.* **76**, 4050-4053 (1994).

33. K.M. Yu, J.W. Ager III, E.D. Bourret, J. Walker, and W. Walukiewicz, "High dose Cl implantation in ZnSe: impurity incorporation and radiation damage," *J. Appl. Phys.* **75**, 1378-1383 (1994).
34. S.S. Perry, J.W. Ager III, G.A. Somorjai, R.J. McClelland, and M.D. Drory, "Interface characterization of CVD-deposited diamond on Ti and Ti-6Al-4V," *J. Appl. Phys.* **74**, 7542-7550 (1994).
35. A.J. Moll, J.W. Ager III, K.M. Yu, W. Walukiewicz, and E.E. Haller, "The effect of co-implantation on the electrical activity of carbon in GaAs," *J. Appl. Phys.* **74**, 7118-7123 (1993).
36. J.A. Wolk, J.W. Ager III, K.J. Duxstad, E.E. Haller, N.R. Taskar, D.R. Dorman, and D.J. Olego, "Local vibrational mode spectroscopy of nitrogen-hydrogen complex in ZnSe," *Appl. Phys. Lett.* **63**, 2756-2759 (1993).
37. A.J. Moll, E.E. Haller, J.W. Ager III, and W. Walukiewicz, "Direct evidence of carbon precipitates in GaAs and InP," *Appl. Phys. Lett.* **65**, 1145-1147 (1994).
38. M.S. Brandt, J.W. Ager III, W. Götz, N.M. Johnson, J.S. Harris Jr., R.J. Molnar, and T.D. Moustakas, "Local Vibrational Modes in Mg-doped Gallium Nitride," *Phys. Rev. B* **49**, 14758-14761 (1994) rapid communication.
39. S. Anders, A. Anders, I.G. Brown, B. Wei, K. Komvopoulos, J.W. Ager III, and K.M. Yu, "Effect of Vacuum Arc Deposition Parameters on the Properties of Amorphous Carbon Thin Films," *Surf. Coatings Tech.* **68** 388-393 (1994).
40. J.A. Wolk, J.W. Ager III, K.J. Duxstad, W. Walukiewicz, E.E. Haller, N.R. Taskar, D.R. Dorman, and D.J. Olego, "The nitrogen-hydrogen complex in ZnSe," *J. Crystal Growth* **138**, 1071-1072 (1994).
41. J.H. Nickel, D.E. Morris, and J.W. Ager III, "Site-selective oxygen substitution in $\text{YBa}_2\text{Cu}_3\text{O}_7$ - Reply," *Phys. Rev. Lett.* **72**, 1389-1389 (1994).
42. J. W. Ager III, W. Walukiewicz, M. McCluskey, M. A. Plano, and M. I. Landstrass, "Fano interference of the Raman phonon in heavily boron-doped diamond films grown by chemical vapor deposition," *Appl. Phys. Lett.* **66**, 616-618 (1995).
43. M. J. Hoffman, Y. W. Mai, R. H. Dauskardt, J. W. Ager III, and R. O. Ritchie, "Grain Size Effects on Cyclic Fatigue and Crack-Growth Resistance Behaviour of Partially Stabilized Zirconia," *J. Mater. Sci.* **30**, 3291-3299 (1995).
44. E. Ibok, S. Garg, G. G. Li, A. R. Forouhi, I. Bloomer, and J. W. Ager III, "Optical Characterization of Amorphous and Polycrystalline Silicon Films," *Solid State Technol.*, **38**(8), S11-S14 (1995).
45. Z. Feng, K. Komvopoulos, D.B. Bogy, J.W. Ager III, S. Anders, A. Anders, Z. Wang and I.G. Brown, "Effect of pretreatment process parameters on diamond nucleation on unscratched silicon substrates coated with amorphous carbon films," *J. Appl. Phys.* **79**, 485-492 (1996).
46. Z. Feng, I. G. Brown, J. W. Ager III, "Electron emission from CVD diamond and amorphous carbon films observed with a simple field emission device," *J. Mater. Res.* **10** 1585-1588 (1995).
47. R. H. Dauskardt and J. W. Ager III, "Quantitative stress mapping in alumina composites by optical fluorescence imaging," *Acta. Materialia* **44**, 625-641 (1996).

48. J. W. Ager III, S. Anders, A. Anders, I. G. Brown, "Effect of intrinsic growth stress on the Raman spectrum of vacuum-arc-deposited amorphous carbon films," *Appl. Phys. Lett.* **66**, 3444-3446 (1995).
49. E. Ibok, S. Garg, G. G. Li, A. R. Forouhi, I. Bloomer, and J. W. Ager III, "Optical characterization of amorphous and polycrystalline silicon films," *Solid State Technol.* **38**, no. 8, s11-s15 (1995).
50. G. M. Pharr, D. L. Callahan, S. D. McAdams, T. Y. Tsui, S. Anders, A. Anders, J. W. Ager III, I. G. Brown, C. S. Bhatia, S. R. P. Silva, and J. Robertson, "Mechanical properties and structure of very hard carbon films produced by cathodic-arc deposition," *Appl. Phys. Lett.* **68**, 779-781 (1996).
51. C. Wetzel, W. Walukiewicz, E. E. Haller, J. W. Ager III, I. Grzegory, S. Porowski, and T. Suski, "Carrier localization in as-grown *n*-type gallium nitride under large hydrostatic pressure," *Phys. Rev. B* **53**, 1322-1326 (1996).
52. M. C. Salvadori, M. Cattani, V. Mammana, O. R. Monteiro, J. W. Ager III, and I. G. Brown, "Fabrication of free-standing diamond membranes," *Thin Solid Films* **290-291**, 157-160 (1996).
53. S. Ruvimov, Z. Liliental-Weber, T. Suski, J. W. Ager III, J. Washburn, J. Krueger, C. Kiselowski, E. R. Weber, H. Amano, and I. Akasaki, "Effect of Si-doping on the dislocation structure of GaN grown on the A-face of sapphire," *Appl. Phys. Lett.* **69**, 990-992 (1996).
54. C. Wetzel, A. L. Chen, T. Suski, and J. W. Ager III, "Si in GaN - on the nature of the background donor," *Phys. Status Solidi B* **198**, 243-249 (1996).
55. Z. Feng, S. Anders, A. Anders, J. W. Ager III, I. G. Brown, K. Komvopoulos, and D. B. Bogy, "Diamond growth on hard carbon films," *Diamond and Related Materials* **10**, 1080-1086 (1996).
56. J. W. Ager III, S. Anders, I. G. Brown, M. Nastasi, and K. C. Walter, "Multilayer hard carbon films with low wear rates," *Surf. Coatings Technol.* **91**, 91-94 (1997).
57. G. M. Zhao, J. W. Ager III, and D. E. Morris, "Site dependence of large oxygen isotope effect in $Y_{0.7}Pr_{0.3}Ba_2Cu_3O_{6.97}$," *Phys. Rev. B* **54**, 14982-14985 (1996).
58. M. D. Drory, J. W. Ager III, T. Suski, I. Grzergory, and S. Porowski, "Hardness and fracture toughness of bulk single crystal gallium nitride," *Appl. Phys. Lett.* **69**, 4044-4046 (1996).
59. C. Kisielowski, J. Kruger, S. Ruvimov, T. Suski, J. W. Ager III, E. Jones, Z. Liliental-Weber, M. Rubin, and E. R. Weber, "Strain-related phenomena in GaN thin films," *Phys. Rev. B* **54**, 17745-17753 (1996).
60. J. W. Ager III, B. Marchon, I. Bloomer, and R. Forouhi, "Optical characterization of carbon overcoats," *Data Storage Tech.* **4**, no. 4, 51-54 (1997).
61. C. Wetzel, T. Suski, J. W. Ager III, E. R. Weber, E. E. Haller, S. Fischer, B. K. Meyer, R. J. Molnar, and P. Perlin, "Pressure induced deep gap state of oxygen in GaN," *Phys. Rev. Lett.* **78**, 3923-3926 (1997).
62. B. Marchon, J. Gui, K. Grannen, G. C. Rauch, J. W. Ager III, S. R. P. Silva, and J. Robertson, "Photoluminescence and Raman spectroscopy in hydrogenated carbon films," *IEEE Trans. Magn.* **33**, 3148-3150 (1997).
63. E. V. Anoikin, M. M. Yang, M. T. Sullivan, J. L. Chao, and J. W. Ager III, "Effects of substrate cooling in hard magnetic disk sputtering process on protective overcoat and magnetic layer properties," *Acta Materialia* **46**, 3787-3791 (1998).

64. S. Anders, J. W. Ager III, G. M. Pharr, T. Y. Tsui, and I. G. Brown, "Heat treatment of cathodic arc deposited hard carbon films, *Thin Solid Films* **308**, 186-190 (1997).
65. S. Anders, J. Díaz, J. W. Ager III, R. Y. Lo, and D. B. Bogy, "Thermal stability of hard carbon films produced by cathodic-arc deposition," *Appl. Phys. Lett.* **71**, 3367-3369 (1997).
66. J. A. Knapp, D. M. Follstaedt, S. M. Myers, J. C. Barbour, T. A. Friedmann, J. W. Ager III, O. R. Monteiro, and I. G. Brown, "Finite-element modeling of nanoindentation for evaluating mechanical properties of MEMS materials," *Surf. Coatings Technol.* **103-104** 268-275, (1998).
67. W. Shan, J. W. Ager III, W. Walukiewicz, E. E. Haller, B. D. Little, J. J. Song, M. Shurman, Z. C. Feng, R. A. Stall, and B. Goldenberg, "Near-band-edge emissions in $\text{Al}_x\text{Ga}_{1-x}\text{N}$ under high pressure," *Appl. Phys. Lett.* **72**, 2274-2276 (1998).
68. W. Shan, P. Perlin, J. W. Ager III, W. Walukiewicz, E. E. Haller, M. D. McCluskey, N. M. Johnson, and D. P. Bour, "Comparison study of photoluminescence from InGaN/GaN multiple quantum wells and InGaN epitaxial layers under large hydrostatic pressure," *Appl. Phys. Lett.* **73**, 1613-1615 (1998).
69. W. Shan, P. Perlin, J. W. Ager III, W. Walukiewicz, E. E. Haller, M. D. McCluskey, and N. M. Johnson, "Pressure dependence of optical transitions in $\text{In}_{0.15}\text{Ga}_{0.85}\text{N}/\text{GaN}$ multiple quantum wells," *Phys. Rev. B* **58**, 10191-10194 (1998).
70. W. Shan, W. Walukiewicz, J. W. Ager III, E. E. Haller, J. F. Geisz, D. J. Friedman, J. M. Olson, and S. R. Kurtz, "Band anticrossing in GaInNAs alloys," *Phys. Rev. Lett.* **82**, 1221-1224 (1999).
71. P. Perlin, T. Suski, J. W. Ager III., G. Conti, A. Polian, N. E. Christensen, I. Gorczyca, I. Grzegory, E. R. Weber, E. E. Haller, "Transverse effective charge and its pressure dependence in gallium nitride single crystals," *Phys. Rev. B* **60**, 1480-1483 (1999).
72. C. Gilbert, J. W. Ager III, V. Schroeder, R. O. Ritchie, J. Lloyd, and J. Graham, "Light emission during fracture of a Zr-Ti-Ni-Cu-Be bulk metallic glass," *Appl. Phys. Lett.* **74**, 3809-3811 (1999).
73. J. W. Ager III, S. Anders, A. Anders, B. Wei, X. Y. Yao, I. G. Brown, C. S. Bhatia, and K. Komvopoulos, "Ion implantation post-processing of amorphous carbon films," *Diamond and Related Mater.* **8**, 451-456 (1999).
74. W. Shan, J. W. Ager III, W. Walukiewicz, E. E. Haller, M. D. McCluskey, N .M. Johnson, D. P. Bour, "Pressure Dependence of Optical Transitions in InGaN/GaN Multiple Quantum Wells," *MRS Internet J. Nitride Semicond. Res.* **4S1**, G3.15 (1999).
75. W. Shan, J. W. Ager III, K. M. Yu, W. Walukiewicz, E. E. Haller, M. C. Martin, W. R. McKinney, and W. Yang, "Dependence of the fundamental band gap of $\text{Al}_x\text{Ga}_{1-x}\text{N}$ on alloy composition and pressure," *J. Appl. Phys.* **85**, 8505-8507 (1999).
76. L. T. Romano, C. G. Van de Walle, R. Lau, J. W. Ager III, W. Götz, and R. S. Kern, "Effect of Si doping on the strain and defect structure of GaN thin films," *Physica B* **273-274**, 50-53 (1999).
77. C. Wetzel, J. W. Ager, B. K. Meyer, H. Amano and I. Akasaki, "Correlation of vibrational modes and DX-like centers in GaN:O," *Physica B* **273-274**, 109-112 (1999).
78. W. Shan, W. Walukiewicz, J. W. Ager III, E. E. Haller, J. F. Geisz, D. J. Friedman, J. M. Olson, and S. R. Kurtz, Effect of nitrogen on the band structure of GaInNAs alloys," *J. Appl. Phys.* **86**, 2349-2351 (1999).
79. S. Dimitrijevic, J. C. Withers, V. P. Mammana, O. R. Monteiro, J. W. Ager III, and I. G. Brown, "Electron emission from carbon nanotubes and ta-C coated nanotubes," *Appl. Phys. Lett.* **75**, 2680-2682 (1999).

80. W. Shan, K. M. Yu, W. Walukiewicz, J. W. Ager III, E. E. Haller, and M.C. Ridgway, "Reduction of band-gap energy in GaNAs and AlGaNAs synthesized by N⁺ implantation," *Appl. Phys. Lett.* **75**, 1410-1412 (1999).
81. C. Wetzel, H. Amano, I. Akasaki, J. W. Ager III, T. Suski, M. Topf, and B. K. Meyer, "Localized vibrational modes in GaN:O tracing the formation of oxygen DX-like centers under hydrostatic pressure," *Phys. Rev. B* **61**, 8202-8206 (2000).
82. C. Skierbiszewski, P. Perlin, P. Wisniewski, T. Suski, W. Walukiewicz, W. Shan, J. W. Ager, E. E. Haller, J. F. Giesz, D. J. Friedman, J. M. Olson, and S. R. Kurtz, "Effect of Nitrogen-Induced Modification of the Conduction Band Structure on Electron Transport in GaAsN Alloys, *Phys. Stat. Sol. B* **216**, 135-139 (1999).
83. L. T. Romano, C. G. Van de Walle, J. W. Ager III, W. Götz, and R. S. Kern, "Effect of Si doping on strain, cracking, and microstructure in GaN thin films grown by metalorganic chemical vapor deposition," *J. Appl. Phys.* **87**, 7745-7752 (2000).
84. C. Skierbiszewski, P. Perlin, P. Wisniewski, W. Knap, and T. Suski, W. Walukiewicz, W. Shan, K. M. Yu, J. W. Ager, and E. E. Haller, J. F. Geisz and J. M. Olson, "Large, nitrogen-induced increase of the electron effective mass in In_yGa_{1-y}N_xAs_{1-x}," *Appl. Phys. Lett.* **76**, 2409-2411 (2000).
85. W. Shan, W. Walukiewicz, K. M. Yu, J. Wu, J. W. Ager III, E. E. Haller, H. P. Xin, and C. W. Tu, "Nature of the fundamental band gap in GaN_xP_{1-x} alloys," *Appl. Phys. Lett.* **76**, 3251-3253 (2000).

II. Other publications.

1. G. M. Rosenblatt, J. W. Ager III, and D. K. Veirs, "Interference effects in the Raman spectroscopy of thin films," in XII International Conference on Raman Spectroscopy, edited by J. R. Durig and J. F. Sullivan (Wiley, New York, 1990), pp. 334-335.
2. D. K. Veirs, J. W. Ager III, and G. M. Rosenblatt, "Mapping chemical and physical properties of advanced materials using spatially resolved Raman spectroscopy," in XII International Conference on Raman Spectroscopy, edited by J. R. Durig and J.F. Sullivan (Wiley, New York, 1990), pp. 898-899.
3. J. W. Ager III, D. K. Veirs, B. Marchon, N.-H. Cho, and G. M. Rosenblatt, "Vibrational Raman characterization of hard carbon and diamond films," in Applied Spectroscopy in Material Science, edited by D. D. Saperstein, Proc. SPIE 1437, pp. 24-31 (1991).
4. J. W. Ager III, D. K. Veirs, H. Q. Lee, and G. M. Rosenblatt, "Profiling and mapping of advanced materials using spatially resolved Raman spectroscopy," in Microbeam Analysis - 1991, edited by D.G. Howitt (San Francisco Press, San Francisco, 1991), pp. 105-108.
5. J. W. Ager III and G. M. Rosenblatt, "Spatially resolved Raman and photoluminescence spectroscopy of advanced materials," in Proc. 50th Annual Meeting of the Electron Microscopy Society of America, ed. G.W. Bailey, J. Bentley, and J. A. Small (San Francisco Press, San Francisco, 1992), pp. 1516-1517.
6. J.W. Ager III, S. Han, R.S. Wagner, L.S. Pan, D.R. Kania, and S.M. Lane, "Characterization of CVD diamond films by optical spectroscopies," in Mater. Res. Soc. Proc., Spring, 1993.
7. K.M. Yu, J.W. Ager III, E. Bourret, N. Derhacobian, R. Giauque, J.M. Jaklevic, P. Becla, C. Rossington, W. Walukiewicz, M. Wesela, and X. Yao, "EXAFS analysis of dilute magnetic

- semiconductor thin films synthesized by ion beam technique," in Mater. Res. Soc. Proc., Spring, 1993.
- 8. S. Im, J. Washburn, N. W. Cheung, K. M. Yu, and J.W. Ager III, "Reducing dislocation density by sequential implantation of Ge and C in Si," Mater. Res. Soc. Proc., Spring, 1993.
 - 9. J.W. Ager III and G.M. Rosenblatt, "Raman characterization of vacuum-arc deposited hard carbon film," in Proceedings of the 3rd Symposium on Diamond Materials, Electrochemical Society.
 - 10. H. Kagan, K.K. Gan, R. Kass, R. Malchow, F. Morrow, W.F. Palmer, C. White, S. Zhao, S. Schnetzer, M.H. Lee, S.K. Kim, F. Sannes, R. Stone, G. Thomson, D. Kania, S. Han, L.S. Pan, Y. Sugimoto, A. Fry, S. Kanda, S. Olsen, M. Franklin, J. Angus, S.J. Ma, J.W. Ager III, and R. Wagner, "Diamond radiation detectors for the Superconducting Super Collider," in 2nd International Conference on the Applications of Diamond Films and Related Materials, ed. M. Yoshikawa, M. Murakawa, Y. Tzeng, and W.A. Yarbrough (NYU, Tokyo, 1993), pp. 29-34.
 - 11. A.J. Moll, J.W. Ager III, K.M. Yu, W. Walukiewicz, and E.E. Haller, "The Effect of Amorphous Layer Regrowth on Carbon Activation in GaAs and InP," in Mater. Res. Soc. Proc., Fall, 1993.
 - 12. J. A. Wolk, J. W. Ager III, K. J. Duxstad, E. E. Haller, N. R. Taskar, D. R. Dorman, and D. J. Olego, "Optical Spectroscopy of a Nitrogen-Hydrogen Complex in ZnSe," in Mater. Res. Soc. Proc., Fall, 1993.
 - 13. S. Anders, A. Anders, I. G. Brown, B. Wei, K. Komvopoulos, J. W. Ager III, and K. M. Yu, "Effect of Vacuum Arc Deposition Parameters on the Properties of Amorphous Carbon Thin Films," Proceedings of the International Conference on Metallurgical Coatings and Thin Films, April 1994.
 - 14. J. W. Ager III, "Residual Stress in Diamond and Amorphous Carbon Films," in Mater. Res. Soc. Proc. **383**, 143 (1995).
 - 15. S. Anders, A. Anders, J. W. Ager III, Z. Wang, G. M. Pharr, T. Y. Tsui, I. G. Brown, and C. S. Bhatia, "Mechanical properties of amorphous hard carbon films prepared by cathodic-arc deposition," in Mater. Res. Soc. Proc. Vol 383, pp. 453-4458 (1995).
 - 16. J. W. Ager III, S. Anders, A. Anders, B. Wei, X. Y. Yao, I. G. Brown, C. S. Bhatia, and K. Komvopoulos, "Ion implantation post-processing of amorphous carbon films, Proceedings of the International Conference on Metallurgical Coatings and Thin Films, April 1995.
 - 17. B. Marchon, J. W. Ager III, I. Bloomer, and A. R. Forouhi, "Optical characterization of carbon overcoats on magnetic disks," Proceedings of the International Conference on Metallurgical Coatings and Thin Films, April 1995.
 - 18. S. Anders, A. Anders, C. S. Bhatia, S. Raoux, D. Schneider, J. W. Ager III, and I. G. Brown, "Properties of vacuum arc deposited amorphous hard carbon films, Proceedings of the Applied Diamond Conference, August 1995.
 - 19. S. Han, G. Rodriguez, A. Taylor, M. A. Plano, M. D. Moyer, M. A. Moreno, L. S. Pan, D. B. Black, H. Burdette, J. W. Ager III, and A. L. Chen, "Correlation of electrical properties with defects in a homoepitaxial CVD diamond," in *Diamond for Electronic Applications*, ed. D. L. Dreifus, A. Collins, T. Humphreys, and K. Das, (Materials Research Society, Pittsburgh, PA, 1996) pp. 343-348.
 - 20. C. Wetzel, S. Fischer, W. Walukiewicz, J. W. Ager III, E. E. Haller, I. Grzegory, S. Porowski, and T. Suski, "Defect Studies of GaN under Large Hydrostatic Pressure, in Mater. Res. Soc. Proc., Fall, 1995.

21. J. Krueger, S. Ruvimov, T. Suski, J. W. Ager III, W. Swider, J. Washburn, and I. Akasaki, Effect of Si-doping on the structure of GaN grown by MOVPE on (1120), Mater. Res. Soc. Symp. Proc. **423**, 487 (1996).
22. Z. Liliental-Weber, S. Ruvimov, T. Suski, J. W. Ager III, C. Kisielowski, and E. R. Weber, "Effect of Si doping on the structure of GaN, in *III-Nitride, SiC and Diamond Materials for Electronic Devices*, ed. D. K. Gaskill, C. D. Brandt, and R. J. Nemanich,, (Materials Research Society, Pittsburgh, PA, 1996), pp. 487-493.
23. J. Krueger, C. Kisielowski, T. Suski, S. Ruvimov, Z. Liliental-Weber, J. W. Ager III, M. Rubin and E. R. Weber, "Strain effects in GaN thin film growth," Proceedings of the IEEE Semi-insulating and Semiconducting Materials Conference SIMC-9, ed. C. Fontaine, May, 1996
24. C. Wetzel, T. Suski, J. W. Ager III, W. Walukiewicz, S. Fischer, and B. K. Meyer, "Strongly localized donor level in oxygen-doped gallium nitride," 23rd Int. Conf. on the Physics of Semiconductors, Berlin, Germany, July 21-26, 1996 (World Scientific, Singapore, 1996), p. 2929.
25. T. Suski, J. W. Ager III, G. Conti, Z. Liliental-Weber, et al., "Effect of Si-doping on physical properties of gallium nitride layers," 23rd Int. Conf. on the Physics of Semiconductors, Berlin, Germany, July 21-26, 1996 (World Scientific, Singapore, 1996), p. 2917-20.
26. C. Kisielowski, J. Krueger, M. Leung, R. Klockenbrinck, S. Ruvimov, Z. Liliental-Weber, and J. W. Ager III, "Origin of strain in GaN thin films," .23rd Int. Conf. on the Physics of Semiconductors, Berlin, Germany, July 21-26, 1996 (World Scientific, Singapore, 1996), pp. 513-16
27. J. A. Knapp, D. M. Follstaedt, J. C. Barbour, S. M. Meyers, J. W. Ager III, O. R. Monteiro, and I. G. Brown, "Evaluating mechanical properties of thin layers using nanoindentation and finite-element modeling: implanted metals and deposited layers," in *Materials Modification and Synthesis by Ion Beam Processing Symposium*, ed. D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, (Materials Research Society, Pittsburgh, PA, 1997) pp. 617-625.
28. J. W. Ager III, I. Brown, O. Monteiro, J. A. Knapp, D. M. Follstaedt, M. Nastasi, K. C. Walter, and C. J. Maggiore, "Growth and mechanical and tribological characterization of multi-layer hard carbon films," in *Materials Modification and Synthesis by Ion Beam Processing Symposium*, ed. D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, (Materials Research Society, Pittsburgh, PA, 1997) pp. 581-585.
29. J. W. Ager III, T. Suski, S. Ruvimov, J. Krueger, G. Conti, E. R. Weber, M. D. Bremser, R. Davis, and C. P. Kuo, "Intrinsic and thermal stress in gallium nitride epitaxial films," in *III-V Nitrides Symposium*, Ed. F. A. Ponce, T. D. Moustakas, I. Akasaki, and B. A. Monemar (Materials Research Society, Pittsburgh, PA, 1997), pp. 775-780.
30. C. Wetzel, W. Walukiewicz, and J. W. Ager III, "Electron-phonon scattering in Si-doped GaN," in *III-V Nitrides Symposium*, Ed. F. A. Ponce, T. D. Moustakas, I. Akasaki, and B. A. Monemar (Materials Research Society, Pittsburgh, PA, 1997), pp. 567-72.
31. O. R. Monteiro, M. P. Delplancke-Ogletree, I. G. Brown, J. W. Ager III, "Deposition and properties of doped diamondlike carbon films produced by dual-source vacuum arc plasma immersion," in *Materials Modification and Synthesis by Ion Beam Processing Symposium*, ed. D. E. Alexander, N. W. Cheung, B. Park, and W. Skorupa, (Materials Research Society, Pittsburgh, PA, 1997) pp. 599-604.
32. K. Bobb, D. B. Bogy, J. W. Ager III, D. Brown, and E. Thear, "Relative wear durability of advanced slider coatings on carbon coated disks, UCB Computer Mechanics Laboratory Report, May, 1997.

33. C. Wetzel, H. Amano, I. Akasaki, T. Suski, J. W. Ager III, E. R. Weber, E. E. Haller, and B. K. Meyer, "Localized donors in GaN: spectroscopy using large pressures," in *Nitride Semiconductors Symposium*, ed. F. A. Ponce, S. P. DenBaars, B. K. Meyer, and S. Nakamura, (Materials Research Society, Pittsburgh, 1998). pp. 489-500.
34. J. W. Ager III, G. Conti, L. T. Romano, and C. Kisielowski, "Stress gradients in heteroepitaxial gallium nitride films," in *Nitride Semiconductors Symposium*, ed. F. A. Ponce, S. P. DenBaars, B. K. Meyer, and S. Nakamura, (Materials Research Society, Pittsburgh, 1998). pp. 769-774.
35. D. M. Follstaedt, J. A. Knapp, S. M. Myers, M. T. Dugger, T. A. Friedmann, J. P. Sullivan, T. Christenson, J. W. Ager III, O. R. Monteiro, and I. G. Brown, "Energetic particle synthesis of metastable layers for superior mechanical properties," in *Atomistic Mechanisms in Beam Synthesis and Irradiation of Materials*, ed. J. C. Barbour, S. Roorda, and D. Ila, (Materials Research Society, Warrendale, PA, 1998).
36. A. Kant, J. W. Ager III, W. J. Moberly-Chan, R. O. Ritchie, M. D. Drory, and N. R. Moody, "Microstructural effects on the hardness, elastic modulus, and fracture toughness of CVD diamond films," in *Thin-Film Stresses and Mechanical Properties VII*, ed. R.C. Cammarata, E.P. Busso, M. Nastasi, and W.C. Oliver, (Materials Research Society, Warrendale, PA, 1998).
37. J. A. Knapp, D. M. Follstaedt, T. A. Friedmann, A. J. Magerkurth, S. W. Clarke, O. R. Monteiro, J. W. Ager III, I. G. Brown, B. N. Lucas, and W. C. Oliver, "Finite-element modeling of nanoindentation for evaluating mechanical properties of thin diamond-like carbon layers," in *Thin-Film Stresses and Mechanical Properties VII*, ed. R.C. Cammarata, E.P. Busso, M. Nastasi, and W.C. Oliver, (Materials Research Society, Warrendale, PA, 1998).
38. J. W. Ager III, "Overview of Optical Microscopy and Optical Microspectroscopy" in *Characterization and Metrology for ULSI Technology*, ed. D. G. Seiler A. C. Diebold, W. M. Bullis, T. J. Shaffner, R. McDonald, and E. J. Walters (AIP Press, New York, 1998).
39. W. Shan, J. W. Ager III, W. Walukiewicz, E. E. Haller, *et al.*, "High pressure study of III-nitrides and related heterostructures," in *High-Pressure Materials Research Symposium*, ed. R. M. Wentzcovitch, R. J. Hemley, W. J. Nellis, and P. Y. Yu (Materials Research Society, Warrendale, PA, 1998), p. 361-70.
40. J. W. Ager III, O. R. Monteiro, I. G. Brown, D. M. Follstaedt, J. A. Knapp, M. T. Dugger, and T. R. Christenson, "Performance Of Ultra Hard Carbon Wear Coatings on Microgears Fabricated By LIGA," in *Materials Science of Microelectromechanical Systems (MEMS) Devices*, ed. A.H. Heuer and S.J. Jacobs, Yu (Materials Research Society, Warrendale, PA, 1999).
41. W. Shan, J. W. Ager III, W. Walukiewicz, and E. E. Haller, "Optical processes in $\text{In}_x\text{Ga}_{1-x}\text{N}$ epitaxial films grown by metalorganic chemical vapor deposition," in *Proceedings of the 10th Conference on Semiconducting and Insulating Materials (SIMC-X)*, eds. Z. Liliental-Weber and C. Miner (IEEE, Piscataway, NJ, 1999), pp. 243-246.
42. W. R. McKinney, M. C. Martin, J. M. Byrd, R. Miller, M. Chin, G. Portman, E. J. Moler, T. Lauritzen, J. P. McKean, M. West, N. Kellogg, V. Zhuang, P. N. Ross, J. W. Ager, W. Shan, and E. E. Haller, "First infrared beamlines at the ALS: final commissioning and new end stations," in *Accelerator-based Sources of Infrared and Spectroscopic Applications*, Proceedings of the SPIE - The International Society for Optical Engineering **3775**, 37-43 (1999).
43. W. Shan, J. W. Ager III, W. Walukiewicz, and E. E. Haller, "Pressure dependence of optical transitions in InGaN/GaN multiple quantum wells," in *GaN and Related Alloys. Symposium*, ed. S. J. Pearson, C. Kuo, and A. F. Wright (Materials Research Society, Warrendale, PA 1999). pp. G3.15-16.

III. Presentations

1. "Raman intensity and interference effects for thin films adsorbed on metals," Pacific Coast Conference on Chemistry and Spectroscopy, American Chemical Society, Pasadena, CA, Oct., 1989. Contributed talk.
2. "Characterization of CVD diamond thin films by imaging Raman spectroscopy," Thirteenth Surface/Interface Research Meeting of the Northern California Chapter of the American Vacuum Society, SRI International, Menlo Park, CA, June, 1990. Poster.
3. "Mapping the chemical and physical properties of advanced materials using spatially resolved Raman spectroscopy," International Conference on Raman Spectroscopy, Columbia, SC, Aug., 1990. Poster.
4. "Raman Characterization of diamond and amorphous carbon thin films," Pacific Conference on Chemistry and Spectroscopy, American Chemical Society, San Francisco, CA, Oct., 1990. Contributed talk.
5. "Vibrational Raman Characterization of Hard Carbon and Diamond Films," SPIE OE/LASE meeting, Los Angeles, CA, January 1991. Invited talk.
6. "Raman spectroscopy characterization of advanced materials," Seagate Magnetics, Fremont, CA, Dec, 1990. Invited talk.
7. "Profiling and mapping of advanced materials using spatially resolved Raman spectroscopy," for Electron Microscopy Society of America/Microbeam Analysis Society Annual Meeting, San Jose, CA, Aug., 1991. Contributed talk.
8. "Characterization of advanced materials using Raman spectroscopy," Applied Materials, Santa Clara, CA, Aug., 1991. Invited talk
9. "Effect of detector quantum efficiency on mapping materials properties using spatially resolved Raman spectroscopy," Optical Society of America Conference on Quantum-limited Imaging, San Jose, CA, Nov., 1991. Contributed talk.
10. "Imaging Raman and photoluminescence characterization of natural and CVD diamond detectors," SSC Diamond Detector Workshop, San Ramon, CA, April, 1992. Invited talk.
11. "Raman and photoluminescence characterization of CVD diamond films," Crystallume, Menlo Park, CA, June, 1992. Invited talk.
12. "Optical characterization of sputtered carbon films," IEEE Magnetic Recording Conference, Santa Clara, CA, July, 1992. Invited talk.
13. "Spatially resolved Raman and photoluminescence spectroscopy of advanced materials," Microbeam Analysis Society Annual Meeting, Boston, MA, Aug., 1992. Contributed talk.
14. "Characterization of CVD diamond films by optical spectroscopies," Materials Research Society Spring Meeting, San Fransisco, CA, March 1993. Contributed talk.
15. "Raman spectroscopy characterization of surfaces and interfaces," MSD/LBL Surface Science Instrumentation Workshop, Berkeley, CA, May 1993. Invited talk.
16. "Imaging Raman Characterization of Advanced Materials," Federation of Analytical Chemistry and Spectroscopy XX, Detroit, MI, October 1993. Invited talk.

17. "Photoluminescence of Sputtered Amorphous Carbon Films," Seagate Magnetics, Fremont, CA, November, 1993. Invited talk.
18. "Optical Characterization of Advanced Materials," Materials Science and Mineral Engineering Departmental Seminar, University of California at Berkeley, Berkeley, CA, November 1993. Invited talk.
19. "Raman and Photoluminescence Spectroscopy of CVD Diamond," Diamond Thin Film Seminar, Stanford University, Palo Alto, CA, November 1993. Invited talk.
20. "Plasma Immersion Implantation Post-processing for Ultrahard Carbon Films," BES/DOE Center for Synthesis and Processing Workshop, Dallas, TX, April 1994. Invited talk.
21. "Quantitative Stress Mapping in Alumina Composites by Imaging Spectroscopy," 96th Annual Meeting of the American Ceramics Society, Indianapolis, IN, April 1994. Contributed Talk.
22. "Structure, Properties, and Applications of Carbon Thin Films," Center for Materials Research seminar, Los Alamos National Laboratory, Los Alamos, NM, October, 1994. Invited talk.
23. "Structure, Properties, and Applications of Carbon Thin Films," Materials Science Division Surface Science Seminar, Lawrence Berkeley Laboratory, Berkeley, CA, October, 1994. Invited talk.
24. "Amorphous Diamond Flat Panel Displays," SI Diamond Kick-Off Workshop, Austin, TX, November, 1994. Invited talk.
25. "Residual Stress in Diamond and Amorphous Carbon Films," Materials Research Society Spring Meeting, San Francisco, CA, April, 1995. Invited talk.
26. "Measurement and Control of Stress in Diamond-Like Carbon Films," International Conference on Metallurgical Coatings and Thin Films, April, 1995. Contributed talk.
27. "Optical Characterization of Amorphous Carbon Coatings," Surface Science Laboratory Open House, May, 1995. Invited talk.
28. "Depth-resolved Residual Stress Measurements in Homoepitaxial Diamond Films Grown by Chemical Vapor Deposition," 187th Meeting of the Electrochemical Society, Reno, NV, May, 1995. Contributed talk.
29. "Cooperative Research in Materials Sciences at Lawrence Berkeley National Laboratory," IEEE Laser and Electro-optics Society (LEOS), San Francisco, CA, October, 1995. Invited talk.
30. "Optical Characterization of Hard Carbon Films," Komag, Milpitas, CA. November, 1995. Invited lecture series.
31. "Microscopies for Defect Characterization in Semiconductor Manufacturing," Applied Materials, Santa Clara, CA. February, 1996. Invited lecture series.
32. "Optical Characterization of Carbon Overcoats," IDEMA Tribology Symposium, Santa Clara, CA. May, 1996. Invited talk.
33. "Growth and mechanical and tribological characterization of multi-layer hard carbon films," Fall Meeting of the Materials Research Society, Boston, MA. November, 1996. Contributed talk.
34. "Intrinsic and thermal stress in gallium nitride epitaxial films," Fall Meeting of the Materials Research Society, Boston, MA. November, 1996. Contributed talk.
35. "Spatially Resolved Stress Measurements in GaN Epitaxial Layers," Hewlett-Packard Laboratories, May, 1997. Invited talk.

36. "Determination of Field Emission Mechanism in Diamond-Based Cold Cathodes," 20th Surface Interface Research Meeting, Northern California Chapter of the American Vacuum Society, Livermore, CA, June, 1997. Invited talk.
37. "Ion-Beam-Deposited Diamond-Like Carbon Coatings on Ni Substrates," 10th Annual Surface Modification by Ion Beam Bombardment Meeting, Gatlinburg, TN, September, 1997. Invited Talk.
38. "Measurement and Control of Stresses in CVD Diamond Films and Ultrahard Carbon Films," Pacific Coast Regional and Basic Science Division Meeting, American Ceramic Society, San Francisco, CA, October, 1997. Invited Talk.
39. "Optical Microscopy Overview," Analytical Laboratory Manager Working Group Meeting, SEMATECH, Austin, TX, November, 1997. Invited Talk.
40. "Stress Gradients In Heteroepitaxial Gallium Nitride Films," Fall Meeting of the Materials Research Society, Boston, MA. November, 1997. Poster.
41. "Overview of Optical Microscopy and Optical Microspectroscopy," 1998 International Conference on Characterization and Metrology for ULSI Technology," National Institute of Standards and Technology, Gaithersburg, MD. March, 1998. Invited Talk.
42. "Stress Distributions in GaN Epitaxial Films and Devices," 10th Conference on Semiconducting and Insulating Materials, Berkeley, CA. June, 1998. Contributed Talk.
43. "Spatially Resolved Stress Measurements in Thin Film Structures via Raman Spectroscopy," Gordon Conference on Thin Film Mechanical Behavior, Plymouth, NH. June, 1998. Invited Talk.
44. "Beamlne 1.4.1: Tunable Visible and Ultraviolet Light for the Investigation of Wide Bandgap Semiconductors," Advanced Light Source User's Meeting, Berkeley, CA. October, 1998. Poster.
45. "Performance Of Ultra Hard Carbon Wear Coatings On Microgears Fabricated By LIGA," Fall Meeting of the Materials Research Society, Boston, MA. December, 1998. Contributed Talk.
46. "Pressure Dependence of the Fundamental Energy Band Gap of $\text{Al}_x\text{Ga}_{1-x}\text{N}$ alloys," March Meeting of the American Physical Society, Atlanta, GA. March 1999. Contributed Talk.